

1.0 INTRODUCTION

This stormwater Field Sampling Plan (FSP) presents the approach and procedures to implement stormwater sampling activities in early 2007 for the Remedial Investigation/Feasibility Study (RI/FS) of the Portland Harbor Superfund Site (Site). The RI/FS project is currently conducting Round 3A of sampling for various purposes in the river, which will extend well into 2007. Therefore, this stormwater sampling is considered part of the Round 3A sampling. This FSP describes the field sampling and laboratory analysis procedures to accomplish the following types of data collection:

- ~~s~~Stormwater chemistry, ~~t~~Total ~~s~~Suspended ~~s~~Solids (TSS), and associated conventionals; ~~and~~
- ~~S~~stormwater sediment chemistry and associated conventionals; ~~and stormwater runoff volumes.~~

The field study approach, sampling methods, and analyses for stormwater ~~sampling~~ are described in this document.

1.1- BACKGROUND AND CONTEXT

The stormwater investigation approach presented here is based on the December 13, 2006 memorandum (Koch et al. 2006) from the U.S. Environmental Protection Agency (EPA) assigned ~~s~~Stormwater ~~t~~Technical ~~t~~Team for the RI/FS as well as notes from a Portland Harbor managers¹ meeting where the memorandum was discussed on December 20, 2006. The technical team included ~~representatives from~~members of EPA, Oregon Department of Environmental Quality (DEQ), and the Lower Willamette Group (LWG).

The memorandum was the result of detailed discussions of the Stormwater Technical Team conducted in late 2005. The team was convened because it was determined by EPA and LWG that stormwater data were needed to complete the RI/FS, and that such data would have to be collected in the 2006/2007 rainy season to fit within the overall RI/FS project schedule. The timing of this decision allowed a very short time for identification of data needs and a desired sampling framework, which was developed by the Stormwater Technical Team and approved by the Portland Harbor managers by the end of 2006. These timing issues also limited the scope, extent, and methods of stormwater data collection that could be completed by the end of the 2006/2007 rainy season and considered within the framework. For example, actual data collection can only occur over the later portion of this rainy season and sampling of storm events over several rainy seasons is not feasible.

Given these timing limitations, the Stormwater Technical Team evaluated a range of stormwater data collection technical approaches and selected the ones described in this document based on (1) the ability to meet the objectives for data use (described below) as

¹ Portland Harbor mangers include project managers from EPA, DEQ, and LWG.

agreed by the Portland Harbor managers and (2) practicability in terms of schedule, cost, and feasibility.

When using data generated from this FSP for modeling or other estimation tools, it is important to keep in mind the above limitations. Both the small number of storm events sampled (three events³) and the limited timeframe for collecting samples (February through May of a single water year) need to be considered when extrapolating from this data to estimate average annual contaminant loads to the river.

While these discussions were ongoing, the Port of Portland was simultaneously (and continues) implementing an evaluation of potential stormwater sources and impacts at the T-4 Terminal 4 site within the Portland Harbor, where an early action sediment clean up is currently being designed under a separate EPA--approved work plan. The T-4 Terminal 4 stormwater work is intended to address all of the objectives for this FSP as discussed below. Consequently, the Port volunteered to include these T-4 Terminal 4 sites within the overall RI/FS stormwater investigation and adjust this work to be as consistent as possible with the approach described in this FSP. Because the T-4 Terminal 4 work is ~~on-going~~ongoing, there may be minor differences in implementation details; however, the overall approaches and scope are consistent.

1.2 SSAMPLING PURPOSE AND OBJECTIVES

The purpose of this sampling and analysis effort is to provide data for evaluating the potential risk and sediment recontamination threat from stormwater discharges to the river. These data will be used for understanding the magnitude of stormwater impacts to the harbor, developing the draft in-river Site RI, identifying stormwater data gaps, and eventually, ~~for~~ evaluating remedial alternatives in the Site FS.

The objectives of the stormwater sampling program were developed in coordination with EPA, DEQ, and the LWG. These objectives are defined as:

- EPA/LWG RI/FS Objectives
 1. Understand stormwater contribution to in-river fish tissue chemical burdens.
 2. Determine the potential for recontamination of sediment (after cleanup) from stormwater inputs.
- ~~DEQ/City of Portland~~DEQ Upland Source Control Objectives
 1. Evaluate stormwater discharges to identify potentially significant hazardous substances that could reach the river.
 - ~~4.~~Identify, prioritize, and control stormwater sources as necessary to prevent contamination of Willamette River water and sediments and recontamination of river sediments following the Portland Harbor cleanup. Determine stormwater sources that now contribute (or could in the future) unacceptably to risks in the river (in terms of direct water or sediment toxicity or bioaccumulation).
 2. Identify and control sources and estimate stormwater contributions to in-river risk after controls.

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The primary focus of this FSP is to obtain data that meet RI/FS objectives, and the Technical Team devised a sampling framework with this intent. However, the team also considered techniques and approaches that could feasibly provide potential overlapping data uses to help meet Source Control Objectives.

It should be noted that in addition to the stormwater data collection described in this FSP, DEQ is pursuing collection of stormwater data at a number of Portland Harbor sites as a part of the Joint Source Control Strategy (JSCS) to meet the above source control objective. ~~The City of Portland is also collecting some~~ Stormwater data are also being collected under stormwater data for various purposes related to stormwater source control. National Pollutant Discharge Elimination System (NPDES) permittees in Portland Harbor. As these data become available, they will be used wherever possible and technically defensible to augment the estimations of stormwater loads based on data collected as described in this FSP to help meet the above RI/FS objectives.

The RI/FS objectives as they relate to this FSP are discussed in more detail below.

1.2.1 Stormwater Contribution to Fish Tissue Burdens

Surface water chemicals are suspected to contribute to fish tissue burdens (and related risks) in the harbor. The importance of various sources of surface water chemicals, particularly stormwater, is not well understood. This lack of understanding could make it difficult to accurately determine sediment (and water) preliminary remediation goals (PRGs) that are intended to minimize fish tissue related risks for the Site.

Thus, it is necessary to determine the relative contribution of stormwater (as compared to other sources) to surface water concentrations of selected chemicals. As noted above, this would be done for stormwater in terms of loading estimates. ~~Thus, to understand the relative stormwater's contribution of stormwater chemicals to fish tissue burdens other sources of chemicals also need to be understood. Other potentially important other sources to the water column and fish tissue that are currently being investigated by the LWG are contributions from upstream and from in-river sediment chemicals. Similar data needs exist for other sources and are addressed elsewhere in RI/FS planning and reporting documents.~~

1.2.2 Stormwater Contribution to Recontamination Potential Evaluation

~~Surface Stormwater discharges have the potential to chemicals may~~ contribute to recontamination of ~~remediated~~ sediments near outfalls (and/or potentially widespread harbor-wide for some chemicals) after cleanup has been completed, ~~if the discharges contain contaminants attached to settling solids.~~ The potential for this outcome must be assessed at an FS-appropriate level of detail to understand the general extent and need for stormwater source controls, ~~at least on a regional basis within the site.~~

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To predict whether sediments would recontaminate at levels above PRGs eventually set for the site, estimates of stormwater loads ~~by outfall (or at least region/segment)~~ are needed ~~for input into estimation tools and models described in Section 1.4. These load estimates must be on a spatial scale consistent with those estimation tools and models. The load estimates should be accompanied by sufficient site-specific measures to assist in the estimation of chemical mass associated with particulates (that may settle to the sediment bed) versus dissolved mass. This requires estimates of loads by modeling segment (as described by Hope 2006) of the river. Estimates of the mass of chemicals present in particulate forms to support Fate and Transport modeling predictions of inputs to and eventual concentrations of chemicals in sediments are also needed.~~

1.3.2 ~~SUMMARY~~ STORMWATER SAMPLING APPROACH

This FSP describes ~~the approach for measuring the concentrations of chemicals in stormwater and for obtaining stormwater flow data at sampling stormwater chemical concentrations and flow at 31 select locations in the Site to meet the above objectives for directly estimating stormwater loads and extrapolation of loads to other unsampled outfalls or modeled river segments. These data will be used, in conjunction with estimation and evaluation tools described below, to assess the nature and extent of chemical loading from stormwater discharges to the site.~~ In summary, the sampling approach ~~at each of these select outfalls/drainage basins involves determined by the technical team is:~~

1. Flow-weighted composite water samples from three storm events including whole water for organic compound analyses and filtered/unfiltered pairs for metals analyses.
2. ~~Additional~~One additional set of grab stormwater samples at 10 of the 31 ~~sampling locations~~ for sampling of filtered/unfiltered pairs and analysis of selected organic compounds.
3. Sediment trap deployment and sampling for a minimum ~~duration~~ of ~~three~~ 3 months.
4. Continuous flow monitoring at each sampling site for the duration of the ~~sampling effort/sediment trap deployment period.~~

The rationale for this sampling approach to meet RI/FS objectives and details of each element of the approach is described in more detail in the remainder of this document.

1.4 ~~DATA USE AND~~ ~~SSAMPLING~~ ~~RRATIONALE~~

Several estimation and evaluation ~~methods and~~ tools will ~~use the collected data to be used meet the above objectives these assessments. The data needs of these tools were considered to help define the type and quantities of data to be collected.~~ The modeling

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tool of primary consideration is EPA's Fate and Transport Model described by Hope (2006). This tool is being used by DEQ to help identify and prioritize the ~~identify/understand~~ stormwater sources that may require source inputs and needed ~~source control~~ measures. It is also being used by EPA/LWG in combination with the LWG-developed in-river Hydrodynamic and Sedimentation Model (West 2005) to directly evaluate the RI/FS objectives above, discussed in the next subsection. In summary, these models require estimates of the data input in terms of chemical mass load (e.g., kg/yr) from each type of contaminant source (e.g., stormwater, groundwater, upstream, etc.) for each of the source estimated along model-defined segments of the river. ~~For stormwater, a chemical mass "load" per unit time (e.g., kg/yr) is needed for each river segment of the model.~~

In general, to estimate stormwater loads, a chemical concentration in stormwater and the volume of stormwater discharge (i.e., time-integrated flows) must be known. These terms ~~in the loading equation~~ can be either directly measured (~~the subject of this FSP~~) or estimated through indirect means (e.g., runoff modeling of stormwater volumes). The following subsections briefly describe how loading estimates will be made using the data collected through this FSP.

1.4.1 Locations

~~Because of the large number of outfalls present at the Site, it was determined by the technical team that sampling of every outfall was infeasible to calculate the needed Site-wide stormwater chemical loads. Consequently, it was decided by the Stormwater Technical Team that a three-pronged approach would be used to balance the need for stormwater data at numerous locations with the feasibility and cost of data collecting it and thus, a subset of outfalls, as described drainage basins, as described in more detail below, will be sampled, for stormwater chemistry and flows. Based on how data will be used in the Site-wide stormwater loading estimates, these basins fall into the following categories:~~

- ~~• Industrial locations with unique or unusual potential chemical sources that cannot be easily extrapolated from generalized land use measurements.~~
- ~~• Locations selected as representative of certain types of land use within the overall drainage area as follows²:~~
 - ~~○ Residential~~
 - ~~○ Major transportation corridors~~
 - ~~○ Heavy industrial~~
 - ~~○ Light industrial~~
 - ~~○ Open space~~

² Note another kind of land use commonly evaluated in stormwater investigations is the "commercial" category, but this is a very minor use within the overall drainage and was judged not to warrant a specific sampling location.

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- Locations selected to directly measure stormwater discharge from relatively large basins that have a mixture of actual land uses and activities within them.

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Data from the first category of locations will be used to directly measure chemical sources at these industrial sites and will not generally be used to extrapolate loadings to other locations or general types of land uses. A primary issue that should be considered when selecting sampling locations is that industrial land uses tend to have relatively high loading rates and can have relatively unique chemical characteristics depending on the particular industrial activities taking place. This results in a high degree of variability in stormwater contaminant concentrations for this land use. Thus, extrapolation of generalized "industrial" loading rates to specific industrial sites may be highly uncertain and could greatly under or overestimate the actual loading from a particular industrial site. For example, extrapolation of polycyclic aromatic hydrocarbon (PAH) loads from general industrial storage type facilities to a former Manufactured Gas Plant site, would be problematic. To address this issue, a higher proportion of sampling locations represent the industrial land use and some sampling locations with specific and/or unique conditions associated with particular industrial activities within the overall Site drainage areas have also been included. In some cases, the unique character of an industrial site may only apply to a certain type of chemical (e.g., metals from the Schnitzer metals handling facility) and other chemicals measured from this site might be used to make loading estimates for general land use categories (e.g., heavy industrial). In general, the data reduction approach is expected to entail pooling the data for each parameter (TSS, water chemical concentration, and sediment chemical concentration), removing the high outlier data (i.e., unique sites) and using the remainder to generate a heavy industry value for use in extrapolation to non-sampled heavy industry areas. Thus, the Industrial category sites should not be viewed as exclusively useful only to directly measure concentrations from these particular sites and may have wider application to the study.

The second category of locations will be combined to make estimates that are intended to be representative of land use categories and will be used in loading estimates for other unsampled areas with the same land uses. This is a commonly used and accepted approach in the field of stormwater management (Schueler 1987). Thus, the land use characteristics of the overall drainage basin for the Site should be described, and to the extent possible, sampling locations that isolate and measure runoff from specific types of land uses should be selected. In general, the greater the proportion of each land use within the overall drainage area, the greater the proportion of sampling locations that should be assigned to that land use. The primary land uses within the overall Site drainage basin, in descending order of total acreage are: parks/open space (e.g., Forest Park), industrial, and residential. The remainder of the drainage areas are composed of mixed land use (e.g., combinations of residential, commercial, and/or industrial), major transportation corridors (e.g., Highway 30 and Interstate 5), and commercial (e.g., shopping areas). Using the land use based extrapolation method, stormwater chemical concentrations measured from (for example) residential land use areas will be applied to other unsampled residential land use areas and converted to extrapolated loads based on

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the estimated volumes of stormwater discharged from those unsampled areas. The resulting series of extrapolations will provide total stormwater loads for these land uses across the entire Site that can be input into the fate and transport model and other estimation tools.

The third category of locations will not be used in land use loading estimates because these locations measure a variety of land uses in one sample. These results will be used as a independent cross-check of extrapolated loads obtained from the second category of land use based estimates for these basins to understand the potential differences between the two methods and uncertainties in the overall approach (i.e., changes between land use locations and discharge to the river, potential for additional sources) to support model input decisions.

The loading estimates for the entire drainage will be obtained by combining information from the first two categories but not the last category. The land use extrapolated estimates are a general representation or “average” estimate of the potential loads from these types of land use. This approach can be inaccurate if substantial unknown unusual conditions lay within any of the unsampled areas. Also, there are limitations to using such data on a small scale since “averages” do not capture the variability that can occur within the overall landscape.

—The data from this subset of outfalls from these sampling locations will be used to extrapolate loading to other outfalls and/or model segments. Most sampling sites were selected to be representative of particular kinds of land uses.

For example, stormwater chemical concentrations measured from residential land use areas will be applied to other unsampled residential land use areas and converted to extrapolated loads based on the estimated volumes of stormwater discharged from those unsampled areas. The resulting series of extrapolations will provide total stormwater loads for the entire Site that can be input into the fate and transport model and other estimation tools. ~~The exact methodology for using measured data and extrapolating chemical and/or flows data to unsampled outfalls or model segments for RI/FS purposes is the subject of ongoing discussions between EPA, DEQ, and the LWG.~~

1.4.2 Measurement Methods

As noted above, water samples and stormwater sediment samples will be collected. These two measurements will provide two independent means of estimating stormwater loads. For whole water chemical concentrations (mass chemical/volume water), these values are multiplied by the volume of water discharging at the location over a set time to yield a load in mass/time. For sediment chemical concentrations (mass chemical/chemical/mass sediment), these values are multiplied by Total Suspended Sediment (TSS) concentrations (mass sediment/volume water) measured in water samples to yield a chemical concentration in water (mass chemical/volume water). This water chemical concentration can then be used to estimate loads identically as described for directly measured water chemical concentrations.

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It is anticipated that these two methods will result in different predictions of mass loading at most sites. The reason for having two independent methods to estimate loads is that each method has some intrinsic measurement artifacts that will lead to varying load estimates. The advantages and disadvantages of each method are to some extent complimentary. By combining the two approaches, the disadvantages of each method can be better understood and the two loading estimates compared to provide a better overall sense of the potential range of chemical loads.

The primary advantage of stormwater sampling is that it provides a direct measure of the chemical concentrations in the water that can be converted to a load in one step (multiplication by volume discharged over a unit time). The disadvantage of stormwater sampling is that it captures one relatively small condition in time. Stormwater chemical concentrations are known to be widely variable depending on a variety of factors such as:

- ~~t~~The specific chemical sources within the drainage basin, which may vary over time and location within the basin
- ~~t~~The characteristics of the storms and their associated runoff (i.e., antecedent dry periods; storm amounts, intensity, and durations; stormwater collection system characteristics; and presence, condition and proper functioning of source controls)
- ~~h~~How and where stormwater is sampled
- ~~w~~When in the storm the samples are collected (i.e., first flush, rising limb, falling limb, etc.).

Ideally, estimation of long-term loads would involve a large number of water samples taken over the course of many years and many types of storms, pollutant sources, and runoff conditions. However, such an approach is rarely acceptable in terms of schedule or budget and is infeasible for this project. Consequently, methods that integrate, average, or estimate long-term chemical concentrations and flows over time are preferred. For this reason, water sampling for this project will be conducted using composite sampling techniques, where a large portion of a runoff event is sampled, rather than one or two grab samples within that runoff event.

The advantage of sediment traps is that they integrate the particulate associated chemical loading over time and avoid the need for large numbers of water chemistry samples. The disadvantage of sediment traps is that (1) they do not estimate the dissolved load and (2) they may preferentially capture only portions of the particulate load (e.g., coarser TSS fractions). Thus, they provide a much less direct measurement of the overall load that may be present in the stormwater being discharged.

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1.4.1 Rationale

With an estimated 250 – 350 (??) stormwater outfalls discharging into the river at the Site, it is not feasible to collect data at each outfall. Consequently, this FSP employs the commonly used approach of applying “representative” estimates of stormwater pollutant concentrations for various land use types (Scheuler 1987). However, this approach has been modified to better fit the unique data needs and land use characteristics of the Site, as well as the practical constraints for this sampling effort as described previously in this document.

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Key considerations contributing to the design of this FSP include the following:

While there are well-substantiated estimates of land use-based pollutant loading rates available from both local and national stormwater management agencies, these estimates generally do not include data on key Portland Harbor Contaminants of Interest. Additionally, the loading rate estimates were developed to meet data needs related to general water quality objectives, which are significantly different from the Portland Harbor data objectives described earlier in this document.

Industrial land uses are of particular concern at this Site. When compared to other land uses at the Site (e.g., residential, commercial, open space), industrial land uses are expected to have higher loading rates of Portland Harbor COIs and may generate runoff with unique chemical characteristics depending on the particular industrial activities taking place at that site. This results in a high degree of variability in stormwater contaminant concentrations for this land use. Thus, caution is needed when using “representative” contaminant concentrations to extrapolate loading estimates from unmeasured drainage basins. Representative concentrations may be applicable for some industrial sites but not for others.

Given these and other considerations, it was decided that a three-pronged approach would be used to balance the need for a robust data set with the feasibility and cost of data collection and the time constraints for this data collection effort. Thus, a subset of drainage basins/outfalls will be sampled. These basins fall into the following categories. The following section describes how the data will be used to estimate loading.

1. Locations selected as representative of certain types of land use within the overall drainage area as follows³:

- o Residential
- o Major transportation corridors
- o Heavy industrial
- o Light industrial
- o Open space

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Commented [KT1]: After each category, insert the estimated percent of total land area in parentheses.

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³ Note another kind of land use commonly evaluated in stormwater investigations is the “commercial” category, but this is a very minor use within the overall drainage and was judged not to warrant a specific sampling location.

2. Industrial locations with unique or unusual potential chemical sources that cannot be easily extrapolated from generalized land use measurements.

3. Locations selected to directly measure stormwater discharge from relatively large basins that have a mixture of land uses and activities within them.

1.4.2 Data Use

Contaminant concentration data from the first category of locations (representative land use sites) will be combined to make estimates that are intended to be representative of land use categories and will be used in loading estimates for other unsampled areas with the same land uses.⁴ For example, stormwater chemical concentrations measured from residential land use areas will be applied to other unsampled residential land use areas and converted to extrapolated loads based on the estimated volumes of stormwater discharged from those unsampled areas. The resulting series of extrapolations will provide total stormwater loads for these land uses across the entire Site that can be input into the fate and transport model and other estimation tools.

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The second category of locations (unique industrial sites) will be used to directly measure chemical sources at these industrial sites. In addition, at sites where the unique chemical character of stormwater only applies to a certain type or types of chemical (e.g., metals from the Schnitzer metals handling facility), the other chemicals measured at this site might be used to make loading estimates for representative land use categories (e.g., heavy industrial). In general, the data reduction approach is expected to entail pooling the data for each parameter (TSS, water chemical concentration, and sediment chemical concentration), removing the high outlier data (i.e., unique sites) and combining the remainder with data from the land use sites to generate a heavy industry value for use in extrapolation to non-sampled heavy industry areas. Thus, data collected at the "unique" industrial sites should not be viewed as exclusively useful only to directly measure concentrations from these particular sites as this data may have wider application to the study.

The third category of locations (basins with a mix of land uses) will not be used in land use loading estimates because these locations measure a variety of land uses in one sample. These results will be used as a independent cross-check of extrapolated loads to help gauge the potential differences between the two methods and uncertainties in the overall approach (i.e., changes between land use locations and discharge to the river, potential for additional sources) to support model input decisions.

The exact methodology for using measured data and extrapolating data to unsampled outfalls or model segments for RI/FS purposes is the subject of ongoing discussions between EPA, DEQ, and the LWG. As this effort moves forward, the limitations of the

⁴ Because industrial sites are expected to demonstrate a higher degree of variability in contaminant concentrations than other land uses, the list of sampling sites includes a higher proportion of industrial land use sites in an attempt to better capture this variability.

data set generated using the methods described above need to be taken into consideration. For example, the land use estimates are a general representation or “average” estimate of the potential loads from these types of land use. This approach can be inaccurate if substantial unusual conditions lay within any of the unsampled areas. Also, there are limitations to using such data on a small scale since “averages” do not capture the variability that can occur within the overall landscape.

1.4.3 Flow Information

Each of the various methods of estimating loads discussed above require some estimate of the volume of water discharged over unit time, which is defined as flow. Flow information will be collected at each location during the duration of the sampling effort. However, the primary use of this flow information will not be in the calculation of stormwater chemicals loads because:

- The period measured is only a portion of the year and loads will need to be estimated on an annual basis
- There will be insufficient time to calibrate flow measurements at each location to arrive at an accurate measurement of flows over the period measured.

The primary purpose of the flow measurements will be to assist in the composite sampling of stormwater on a flow-weighted basis. Flow weighted composite methods are described more below. In summary, the amount of sample taken is proportional to the flow of water present over the time period the sample is intended to represent. Each sample is then combined so that the composite sample is “weighted” based on the flow.

Volumes of water for use in loading estimates will be estimated by independent methods currently being discussed by the Stormwater Technical Team. In general, average annual volumes of discharge for each sampling location will be estimated using runoff estimation and modeling tools that are commonly applied to stormwater loading and conveyance system design.

1.4.4 –Other Considered Measurements and Conditions

Some other techniques and conditions were considered in the sampling design but not selected, and the reasons for such selections, are discussed briefly below.

Sediment traps were selected as the method to measure chemical concentrations on stormwater particulates. Other methods exist to obtain sediment samples such as pumping and filtering large amounts of stormwater and analyzing the solids captured by the filter (and similar methods of capturing particulates in water). Sediment traps were preferred because they are logistically simple to implement and passively capture sediment over a long period and wide range of conditions. By comparison, active

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filtering or capturing techniques are labor intensive and sample over a relatively short period of time, such as hours or perhaps a few days, and thus, have the same time integration limitations as composite stormwater sampling. However, high volume water filtering techniques will be employed if sediment trap deployment is infeasible (e.g., due to space limitations) and are described as a contingency method within this FSP.

The Stormwater Technical Team determined that TSS should be measured in stormwater to support the loading calculations based on sediment trap data as described above. Various methods exist for measuring particulates in stormwater including Suspended Sediment Concentration (SSC) methods developed by the U.S. Geological Survey (USGS). The SCC is reported by the USGS to provide a more accurate determination of the suspended sediment mass in water samples than TSS (Gray et al. 2000). However, TSS method is much more widely used and any historical data sets available for the sampling locations will likely be in the form of TSS. Because this historical information may be valuable in better estimating the range of suspended sediment conditions that might apply to estimates of chemical loads using sediment trap data, it appeared more important to collect any additional suspended sediment data for this program by a consistent means. Consequently, it was determined that the biases introduced by the TSS method are not so great as to warrant the inability to compare historical and new data sets.

The Stormwater Technical Team determined that three composite storm events would be sampled at each location. Greater and lesser numbers of events were considered. Given the time limitations of the study, three events appeared to represent a good balance between the preference for as many stormwater samples as possible to address the variability issues discussed above, the allowable timeframe for the sampling, ~~and~~ the number of appropriate storms that would occur in that period, and costs.

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